



Our Ref.: 2075

Non-Provisional Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Stanford R. Ovshinsky, Boil Pashmakov, David V. Tsu

Serial Number: 09/971,881

Filing Date: October 5, 2001

For: SEMICONDUCTOR WITH COORDINATIVELY
IRREGULAR STRUCTURES

Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Group Art Unit: 1771

Examiner: H. Vo

DECLARATION UNDER 37 CFR 1.132

Dear Sir:

I, Boil Pashmakov, do hereby declare and say:

1. I am an inventor of the invention disclosed in U.S. Pat. Appl. Ser. No. 09/971,881, entitled "SEMICONDUCTOR WITH COORDINATIVELY IRREGULAR STRUCTURES", filed on October 5, 2001.

a. In 1980, I obtained my Master's Degree in Solid State Physics from the Sofia State University in Bulgaria with a thesis on the Kondo effect in doped semiconductors. In 1985, I defended a doctoral thesis and received a Ph.D. in semiconductor physics from the Bulgarian Academy of Sciences. The topic of my doctoral thesis was: Photoconductivity

and electronic transport in disordered semiconductors. From 1990-1994, I worked as a post-doctoral fellow at the University of Chicago on metal-insulator transitions in amorphous metal oxides. I joined Energy Conversion Devices in November of 1994 and have worked there since, where I currently hold the position of Senior Research Scientist. My work at Energy Conversion Devices is in the area of semiconductor materials, with an emphasis on the growth and characterization of thin film semiconductor materials. My primary expertise includes plasma-based growth processes of silicon-based semiconductors (including amorphous silicon, microcrystalline silicon, polycrystalline silicon, and silicon alloys such as SiGe) and the electrical and optical properties of semiconductor and chalcogenide materials. I regularly attend conferences on amorphous and disordered materials and semiconductors as well as the annual meetings of the American Physical Society. I have around 30 technical publications in the field of semiconductor physics and am inventor or co-inventor of about 10 U.S. patents.

2. I am familiar with the Office Action of March 27, 2003, as well as the Ovshinsky reference (US 6,087,580) cited by the Examiner and understand the subject matter thereof.

a. I am familiar with the Office Action of September 15, 2003, as well as the Ozin reference (US 5,320,822) cited by the Examiner and understand the subject matter thereof.

3. I contend that the material disclosed in the subject application 09/971,881 is distinguishable from the material disclosed in the Ovshinsky reference for the following reasons:

a. The central structural unit of the material of subject application 09/971,881 is a coordinatively irregular structure having as a distinguishing feature a bonding configuration of silicon that is distorted from a regular tetrahedral bonding configuration. The non-tetrahedral distortions include angular deviations from the regular tetrahedral bond angle of 109.5° . The presence of these distortions leads to disorder within a coordinatively irregular structure, a lack of periodicity and the establishment of novel properties (e.g. bandgap energy, refractive index) relative to amorphous or crystalline silicon.

b. In contrast, the central structural unit of the material of the Ovshinsky reference (US 6,087,580) is an atomic aggregation that is highly ordered and in the form of ordered clusters where the ordered clusters are crystallites within a certain size range. The atomic aggregations of the Ovshinsky reference show periodicity and propagation of local order, where the length scale over which the periodicity and propagation of local order extends is distinguished from the long range order present in crystalline silicon. The attainment of a highly ordered state showing a degree of periodicity and propagation of local order in the central structural unit of the Ovshinsky reference requires the presence of a bonding configuration for silicon that is either regular tetrahedral or at most shows vanishingly small deviations from the regular tetrahedral bond angle of 109.5° .

c. The non-tetrahedral distortions present in the coordinatively irregular structures of the subject application 09/971,881 are incompatible with the periodicity and propagation of local order present in the atomic aggregations of the Ovshinsky material and lead to the conclusion that the coordinatively irregular structures of the subject application 09/971,881 and the atomic aggregations of the Ovshinsky reference are distinct structural entities.

Whereas the bonding configuration of the coordinatively irregular structures of the subject application 09/971,881 is irregular, the bonding configuration of the atomic aggregations of the material of the Ovshinsky reference is regular.

d. Based on the disclosure of the Ovshinsky reference and my knowledge of the subject matter therein, I assert that the coordinatively irregular structures of the subject application 09/971,881 do not coincide with and are not present in the atomic aggregations of the Ovshinsky reference.

1. Factual evidence in support of my arguments is found in Figs. 1 and 2 of the specification along with the accompanying discussion of Figs. 1 and 2 in the specification (line 1, p. 28 – line 20, p. 33). The factual evidence consists of measurements of the bandgap, Raman spectra and x-ray diffraction spectra of representative embodiments of the claimed semiconductor material. The bandgap data of Fig. 1 show the influence of coordinatively irregular structures on the bandgap of the semiconductor material and demonstrate possession of a silicon based semiconductor material having a bandgap intermediate between the bandgaps of crystalline silicon (1.1 eV) and amorphous silicon (1.8 eV). The Raman data of Fig. 2 show a Raman feature at 490 cm^{-1} attributable to the coordinatively irregular structures in a silicon based embodiment of the invention and Table 2 shows how the relative proportion of coordinatively irregular structures can be varied in different samples prepared according to different growth conditions. The x-ray data show that the coordinatively irregular structures of a silicon based embodiment of the invention have a state of order intermediate between the crystalline and amorphous phases of silicon.

e. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patents issuing thereon.

Signed:

A handwritten signature in cursive script, appearing to read "Boil Pashmakov", written in black ink.

Dr. Boil Pashmakov, Ph.D.

Date: